

STUDY THE IMPORTANT CHARACTERISTICS OF THE MACROCYCLIC COMPLEXES

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Abstract: *The metal-ion and host-guest chemistry of macro cyclic ligands have developed rapidly over recent years and now impinge on wide areas of both chemistry and biochemistry. Macro cyclic ligands are polydentate ligands containing their donor atoms either incorporated in or, less commonly, attached to a cyclic back bone. A large number of synthetic, as well as many natural, macro cycles have now been studied in considerable depth. A major thrust of many of these studies has been to investigate the unusual properties frequently associated with cyclic ligand complexes. In particular, the investigations of spectral, electrochemical, structural, kinetic and thermodynamic aspects of macro cyclic complex formation have all received considerable attention.*

Key Words: *Macro cyclic ligands, Cyclic ligand complexes, host-guest Addition etc.*

1. INTRODUCTION :

The development of the field of bioinorganic chemistry has been an important factor in spurring the growth of interest in the macro cyclic complexes. The possibility of using synthetic macro cycle as model for biologically important system has initiated a broad spectrum of research activities, ranging from synthesis of new ring systems and studies on the properties and function of macro cyclic complexes to their application in industry, medicine and other field. The field of macro cyclic chemistry of metals is developing very fast because of its variety of applications and importance in the area of coordination chemistry. Transition metal complexes with macro cyclic ligands are well known for their enhanced kinetic and thermodynamic stability and to stabilize unusual oxidation states of the coordinating metal ions. The 1987 Nobel Laureate, Charles J. Pederson, Donald J. Cram and Jean-Marie Lehn, provided a common platform for the development of macro cyclic and supramolecular molecules. This provides an importance in the area of bio- and nanotechnology, catalysis, molecular electronics, environmental protection, medicine and photonics. As defined by IUPAC, a macro cycle is "a cyclic macromolecule or a macromolecular cyclic portion of a molecule." As usually defined in coordination chemistry, "a macro cycle is a cyclic molecule consists of minimum of nine atoms with three or more potential donor atoms that can coordinate to a metal atom." According to this definition, ethylene oxide, 1,4-dithiane, cyclotetradecane, cyclooctatetraene are not macro cycles, whereas molecules such as cyclam, cyclen, 1,4,7-trithiacyclononane and dibenzo-18-crown-6 fit the definition.

2. REVIEW OF LITERATURE:

Cobalt(II) macrocyclic complexes which acts as reversible oxygen carrying agents have been synthesized by cobalt(II), nickel(II) and copper(II) complexes with tridentate macrocyclic ligand obtained by the condensation of 2,6-dipicolinyldihydrazide and acetylacetone. These complexes were supposed to have five coordinate trigonal - bipyramidal geometry. They have also synthesized and characterized the macrocyclic complexes obtained by the condensation of diaminopyridine/*m*-phenylenediamine and acetylacetone in the presence of divalent and trivalent transition metal ions. Macrocyclic complexes obtained by the template condensation of 2,6-diacetylpyridine and 1,3-diaminopropane. The cobalt (II), nickel (II) and copper(II) complexes containing fluoroboro-bridged 14- and 16-membered macrocyclic ligands

3. MATERIAL ANDMETHOD:

The most important property of macrocyclic complexes is the macrocyclic effect. Complexes of bidentate and polydentate ligands are more stable than those with unidentate ligands of similar strength. A macrocycle has donor atoms arranged in a more fixed position and thus, there is less of an entropic effect in the binding energy of macrocycles than monodentate or bidentate ligands with an equal number of donor atoms. Thus the macrocyclic effect states that, the complexes with macrocyclic ligands are more stable than those with acyclic polydentate ligands of similar donor atoms. Schiff base macrocycles have been of great importance in macrocyclic chemistry. They were among the first artificial metal macrocyclic complexes to be synthesized. The Schiff bases, an important structural part of the macrocyclic ligands having imine or azomethine groups are obtained by the condensation of an active carbonyl compound and a primary amine. In chemistry, a "template reaction" is a class of ligand-based reactions that occur between two or more adjacent coordination sites on a metal center. In the absence of the metal ion, the same organic

reactants afford different products. The term is mainly used in coordination chemistry. The template effect emphasizes the pre-organization provided by the coordination sphere, although the coordination modifies the electronic properties (acidity, electrophilicity, etc.) of ligands. Macrocyclic complexes are thermodynamically more stable and more selective metal ion binders than their open chain analogues. The macrocyclic complexes present in the living systems are synthesized by biochemical reactions using specific enzymes for different steps involved in their biosynthesis. Macrocycles have been in use for several years as synthetic dyes, e.g. phthalocyanine is a dark blue coloured porphyrin analogue, used as dyes.

4. RESULT:

Macrocyclic metal complexes find great importance due to their wide industrial and biological applications, such as removal of heavy metals from aqueous solution for water purification, use of chelating agents such as EDTA (chelation therapy) to remove heavy metals from the body, chemical sensors, and mimicry of cellular receptors, molecular recognition. The importance of macrocyclic complexes in coordination chemistry is because of its various applications in biological processes such as photosynthesis and dioxygen transport; catalytic properties; potential applications as metal extractants and radiotherapeutic agents. Many of the transition metal ions in the living systems work as enzymes or carriers in macrocyclic ligand-field environment. Some of the transition metal complexes are used in the development of DNA modification agents that can recognize and cleave DNA. Macrocyclic nickel complexes find use in DNA recognition and oxidation while macrocyclic copper complexes find use in the DNA binding and cleavage properties. Copper is a component of a variety of proteins which function as mono-oxygenases, dioxygenases as in dioxygen transport and in electron-transfer systems. Enzymes like hemocyanin, tyrosinase etc. have binuclear copper centers in their active sites. Copper(II) ions play a central role in biological redox metalloenzymes such as plastocyanin, hemocyanin, azurin and galactose oxidase. Metal complexes of macrocyclic ligands can be used as models for biological macrocyclic systems such as metalloporphyrins (hemoglobin, myoglobin, cytochromes, chlorophylls), corrins (vitamin B12) and antibiotics (valinomycin, nonactin). Some of the biologically active macrocyclic complexes are used in the identification of diseased and normal tissues.

5. CONCLUSION:

The important characteristics of the macrocyclic complexes are:

- A marked kinetic inertness both to the formation of the complexes from the ligands and metal ions and to the reverse, the extrusion of the metal ion from the ligand.
- They provide stability to high oxidation states that are not attainable normally, such as Cu(III) or Ni(III).
- They have high thermodynamic stability- the formation constants for N₄ macrocycles may be orders of magnitude greater than the formation constants for nonmacrocyclic N₄ ligands. Thus for Ni²⁺, the formation constant for the macrocycle cyclam is about five orders of magnitude greater than that for the nonmacrocyclic tetradentate.

REFERENCES:

1. D.P. Singh, R. Kumar and P. Tyagi, *Transition Met. Chem.*, **31**, 970 (2006); D.P. Singh, R. Kumar and V. Malik, *Int. J. Chem. Sci.*, **4**, 1031 (2006).
2. R.N. Prasad and M. Sharma, *J. Indian Chem. Soc.*, **83**, 1260 (2006); R.N. Prasad and A. Upadhyay, *J. Indian Chem. Soc.*, **83**, 857 (2006); R.N. Prasad and M. Mathur, *J. Indian Chem. Soc.*, **83**, 1208 (2006).
3. R. Kumar and R. Singh, *Turk. J. Chem.*, **30**, 77 (2006).
4. N. Raman and C. Thangaraja, *Transition Met. Chem.*, **30**, 317 (2005).
5. R.N. Prasad and M. Mathur, *J. Serb. Chem. Soc.*, **67**, 825 (2002).
6. S.G. Kang, J. Song and J.H. Jeong, *Inorg. Chim. Acta*, **357**, 605 (2014).
7. M.J. Robertson, G.N.D. Iuliis, M. Maeder and G.A. Lawrance, *Inorg. Chim. Acta*, **357**, 557 (2004).
8. H. Keypour, H. Khanmohammadi, K.P. Wainwright and S. Jameh-bozorgi, *Transition Met. Chem.*, **29**, 523 (2004).
9. M. Shakir, N. Begum, S. Parveen, P. Chingsubam and S. Tabassum, *Synth. React. Inorg. Met.-Org. Nano-Met. Chem.*, **34**, 1135 (2004).